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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/986,277	11/08/2001	Hideki Takahashi	215551US2	5052

22850 7590 09/11/2002

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EXAMINER

LEWIS, MONICA

ART UNIT PAPER NUMBER

2822

DATE MAILED: 09/11/2002

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/986,277

Applicant(s)

TAKAHASHI, HIDEKI

Examiner

Monica Lewis

Art Unit

2822

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 30 May 2002.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-13 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-13 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 08 November 2001 is/are: a) ☐ accepted or b) ☒ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some * c) ☐ None of:
1. ☒ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) 3 & 4.
- 4) ☐ Interview Summary (PTO-413) Paper No(s). _____
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____

DETAILED ACTION

1. This action is in response to the election filed May 30, 2002.

Election/Restrictions

2. Applicant's election with traverse of Group I in Paper No. 6 is acknowledged. The traversal is on the ground(s) that there is no burden for the examiner. However, this is not found persuasive because searching in a separate area for method (Class 438) and another area for apparatus (Class 257) for two inventions does constitute an undue burden upon the examiner.

The requirement is still deemed proper and is therefore made FINAL.

Drawings

3. Figures 27 and 28 should be designated by a legend such as --Prior Art-- because only that which is old is illustrated. See MPEP § 608.02(g). A proposed drawing correction or corrected drawings are required in reply to the Office action to avoid abandonment of the application. The objection to the drawings will not be held in abeyance.

Claim Objections

4. The claims are objected to because they include reference characters which are not enclosed within parentheses.

Reference characters corresponding to elements recited in the detailed description of the drawings and used in conjunction with the recitation of the same element or group of elements in the claims should be enclosed within parentheses so as to avoid confusion with other numbers or characters which may appear in the claims. See MPEP § 608.01(m).

Specification

5. The title of the invention is not descriptive. A new title is required that is clearly indicative of the invention to which the claims are directed.
6. The lengthy specification has not been checked to the extent necessary to determine the presence of all possible minor errors. Applicant's cooperation is requested in correcting any errors of which applicant may become aware in the specification.

Claim Rejections - 35 USC § 112

7. The following is a quotation of the second paragraph of 35 U.S.C. 112:
- The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.
8. Claims 3-5 and 8 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. It is not clear what is meant by the following: a) "formed in a predetermined direction seen on a plane" (See Claim 3); b) "formed in said predetermined direction seen on a plane" (See Claim 3); c) "partial region" (See Claims 3 and 4); and d) "second trench includes a plurality of second trenches" (See Claim 8). Claim 5 depends directly or indirectly from a rejected claim and are, therefore, also rejected under 35 U.S.C. 112, second paragraph for the reasons set above.

Claim Rejections - 35 USC § 103

9. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

10. Claims 1-11 and 13, as far as understood, are rejected under 35 U.S.C. 103(a) as obvious over Takahashi (U.S. Patent No. 5,960,264) in view of Takahashi (U.S. Patent No. 6,001,678).

In regards to claim 1, Takahashi discloses the following:

- a) a first semiconductor layer (41) of a first conductivity type having first and second major surface (See Figure 3);
- b) a second semiconductor layer (46) of a second conductivity type formed on the first major surface of said first semiconductor layer (See Figure 3);
- c) a third semiconductor layer (42) of the second conductivity type formed on said second semiconductor layer (See Figure 3);
- d) a fourth semiconductor layer (43) of the first conductivity type formed on said third semiconductor layer (See Figure 3);
- e) a first trench and at least one second trench arranged to penetrate through at least said fourth semiconductor layer from a surface of said fourth semiconductor layer (See Figure 3);
- f) a first semiconductor region (44) of the second conductivity type selectively formed in said surface of said fourth semiconductor layer adjacently to said first trench (See Figure 3);
- g) a first insulating film (48) formed on an internal wall of said first trench (See Figure 3);
- h) a control electrode (49) buried in said first trench through said first insulating film (See Figure 3);
- i) a first main electrode (51) electrically connected to at least a part of said first semiconductor region and formed over an almost whole surface of said fourth semiconductor layer (See Figure 3); and
- j) a second main electrode (52) formed on the second major surface of said first semiconductor layer (See Figure 3).

In regards to claim 1, Takahashi fails to disclose the following:

- a) control electrode being not formed in said at least one second trench.

However, Takahashi discloses an electrode not formed in the trench (See Figure 9). It would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the semiconductor device of Takahashi to include a trench without a control electrode as disclosed in Takahashi because it aids reducing the capacity.

In regards to claim 2, Takahashi discloses the following:

a) distance between said first trench and said at least one second trench is set to 5 μm or less (See Column 17 Lines 64-66).

Additionally, the applicant has not established the critical nature of the dimension of 5 μm or less. "The law is replete with cases in which the difference between the claimed invention and the prior art is some range or other variable within the claims. . . . In such a situation, the applicant must show that the particular range is critical, generally by showing that the claimed range achieves unexpected results relative to the prior art range." *In re Woodruff*, 919 F.2d 1575, 16 USPQ2d 1934 (Fed. Cir.1990).

In regards to claim 3, Takahashi discloses the following:

a) first trench includes a trench formed in a predetermined direction seen on a plane (See Figure 3);

b) one second trench includes a trench formed in said predetermined direction seen on a plane (See Figure 3);

c) first semiconductor region includes a first partial region formed in the vicinity of said first trench and a second partial region extended from said first partial region in such a direction as to go away from said first trench (See Figure 3); and

d) first main electrode is directly formed on said second partial region to carry out electrical connection to said first semiconductor region (See Figure 3).

In regards to claim 4, Takahashi discloses the following:

a) a third partial region which is further extended from said second partial region and is formed in the vicinity of said at least one second trench (See Figure 3); and

b) first main electrode is further formed directly on said third partial region to carry out electrical connection to said first semiconductor region (See Figure 3).

In regards to claim 5, Takahashi discloses the following:

a) second and third partial regions include a plurality of second and third partial regions respectively (See Figure 15 and Figure 21); and

b) plurality of third partial regions are selectively formed in the vicinity of said at least one second trench (See Figure 15 and Figure 21).

In regards to claim 6, Takahashi discloses the following:

a) a second semiconductor region of the first conductivity type formed in said surface of said fourth semiconductor layer adjacently to said at least one second trench, said second semiconductor region having a concentration of an impurity of the first conductivity type set to be higher than that of said fourth semiconductor layer (See Figure 3).

In regards to claim 7, Takahashi discloses the following:

a) concentration of said impurity of the first conductivity type in said second semiconductor region is set to be higher than a concentration of an impurity of the second conductivity type in said first semiconductor region (See Figure 3).

In regards to claim 8, Takahashi discloses the following:

a) at least one second trench includes a plurality of second trenches (See Figure 15).

In regards to claim 9, Takahashi discloses the following:

a) first trench and said at least one second trench have equal formation widths (See Figure 3).

In regards to claim 10, Takahashi discloses the following:

a) a second insulating film formed on an internal wall of said at least one second trench (See Figure 3).

In regards to claim 11, Takahashi discloses the following:

a) conductive region buried in said at least one second trench through said second insulating film (See Figure 3).

In regards to claim 13, Takahashi fails to disclose the following:

a) a sixth semiconductor layer of the second conductivity type formed between said first semiconductor layer and said second semiconductor layer, said sixth semiconductor layer having a concentration of an impurity of the second conductivity type set to be higher than that of said second semiconductor layer.

However, Takahashi discloses a sixth layer (61) of the second conductivity type (See Figure 12). It would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the semiconductor device of Takahashi to include a sixth layer of a second conductivity type as disclosed in Takahashi because it aids increasing the switching speed.

11. Claim 12 is rejected under 35 U.S.C. 103(a) as obvious over Takahashi (U.S. Patent No. 5,960,264) in view of Takahashi (U.S. Patent No. 6,001,678) and Uenishi et al. (U.S. Patent No. 5,894,149).

In regards to claim 12, Takahashi fails to disclose the following:


a) first main electrode is directly formed on said conductive region.

However, Uenishi et al. ("Uenishi") discloses an electrode (10) formed on a conductive region (80) (See Figure 42). It would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the semiconductor device of Takahashi to include an electrode formed on a conductive region as disclosed in Uenishi because it aids reducing the area of the trenches.

Conclusion

12. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Monica Lewis whose telephone number is 703-305-3743. If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Carl Whitehead, Jr. can be reached on 703-308-4940. The fax phone number for the organization where this application or proceeding is assigned is 703-308-7722 for regular and after final communications. Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-308-0956.

ML
September 5, 2002


CARL WHITEHEAD, JR.
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